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G4H
Selected US specifications from IPC sub-classes H03K
G09F G09G

(54) Switch/display units

(57) A switch display unit has a dielectric panel 14 and a first set of elongate electrodes 12, preferably radially arranged, is formed on the rear surface of the panel. A display medium 11 is provided to the rear of the radial electrodes and the display medium is between the first set of electrodes 12 and a second set of, preferably annular, concentric electrodes 13. The electrodes of the first and second sets 12 and 13 overlap to form a matrix of dots at their intersections. A conductive layer 15 on the front of the panel 14 is capacitively coupled for sensing a touch operation and effect a switching action. The display medium 11 activated at the dots by applying a potential across the electrodes 12, 13 may include liquid crystals, ionizable gases, electroluminescent, electrochromic or electrophoretic materials.

FIG.1

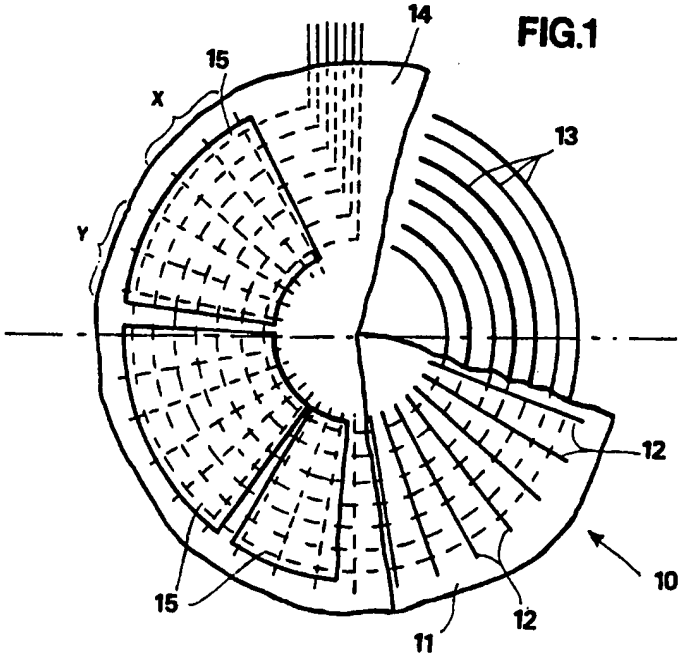

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FIG.1

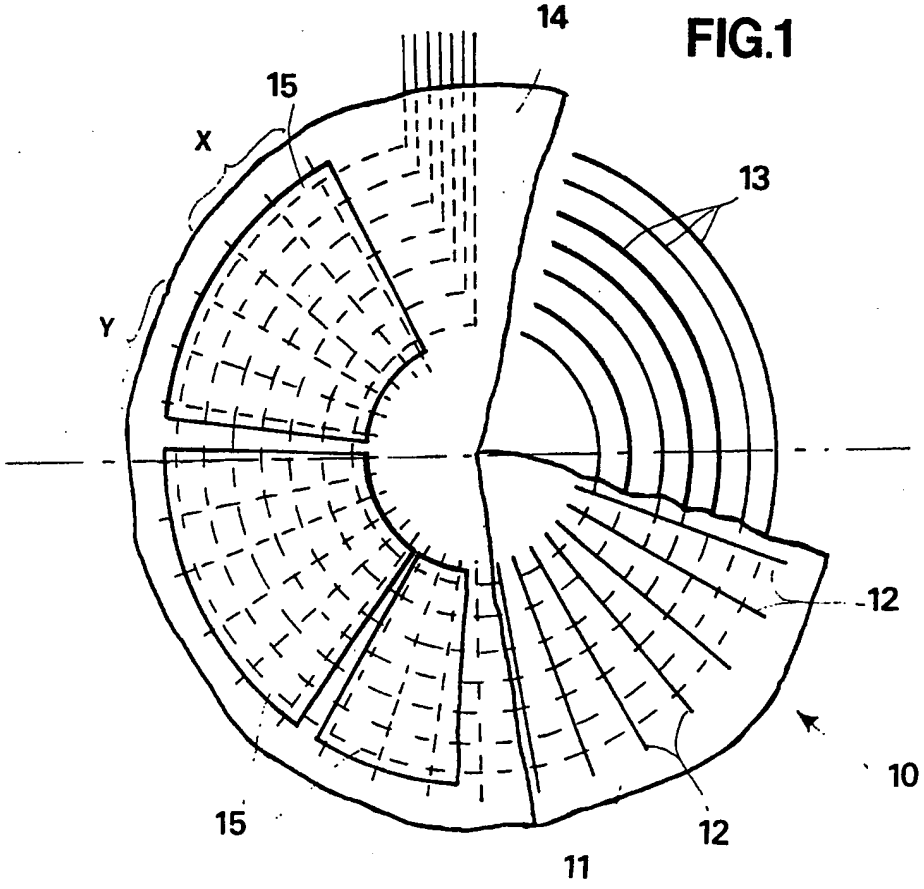
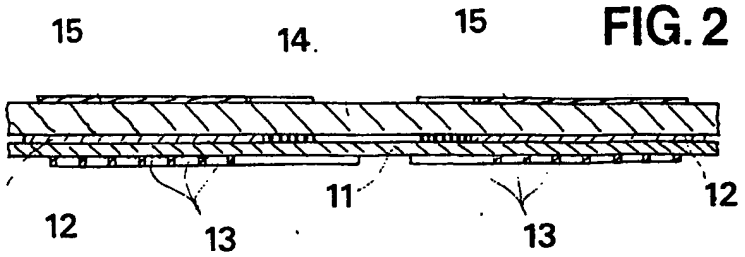


FIG. 2



SPECIFICATION

Switch/display units

The present invention relates to switch/display units.

According to one aspect of the present invention, a switch/display unit comprises, a transparent dielectric panel, a first set of elongate electrodes formed from transparent conductive material on the rear surface of said dielectric panel, a display medium disposed between said first set of electrodes and a second set of elongate electrodes, said electrodes of the first set overlapping those of the second set to form a matrix of dots, each dot defined by the intersection of a unique pair of electrodes, one from the first set and one from the second set, and a transparent conductive layer formed in front of the dielectric panel and overlying the first set of electrodes.

For switching purposes, the first set of electrodes may be divided into two groups, read pulses may be applied to one of these groups of electrodes by means of suitable circuitry. The other group of electrodes may be connected to circuitry capable of sensing the change in signal, due to a change in capacitive coupling between the groups of electrodes when the switch is actuated, and initiating a switching action in response to that change.

Alternatively, additional electrodes may be provided on the rear surface of the dielectric panel to take over the function of one or the other of the groups of electrodes, so that, for example, read pulses may be applied to the whole set of electrodes on the rear face of the dielectric panel and a separate electrode may be used for sensing purposes.

The display medium used will be a material which will react to an electric field which may be established between the electrodes of the first set and those of the second set, to provide a visual change. Such display media include liquid crystals, ionizable gases, electroluminescent materials, electrochromic materials and electrophoretic materials. By applying electrical pulses of sufficient strength to electrodes of the first set and electrodes of the second set, dots defined by the intersection of unique pairs of said electrodes may be activated to form a display.

An embodiment of the invention is now described, by way of example only, with reference to the accompanying

Figure 1 illustrates in cut away plan view a switch/display unit formed in accordance with the present invention; and

Figure 2 shows a section through the switch/display unit illustrated in Figure 1.

The switch/display unit illustrated comprises a polar dot matrix liquid crystal display 10. Said display has a liquid crystal display medium 11 disposed between a first set of radial electrodes 12 and a second set of concentric annular electrodes 13, each radial electrode 12 intersecting each of the annular electrodes 13. In this manner the intersection of each pair of electrodes 12, 13 sandwiches a unique portion of the liquid crystal 11 and this portion of the liquid crystal 11 may be actuated by applying an electrical potential across the electrodes 12, 13 to form a dot. By energising appropriate pairs of electrodes 12, 13 a symbol or legend may be built up from the dots, as required. The potential required to actuate the display is achieved by applying a pulse of positive potential to the electrodes of one of the sets 12, 13 and applying a pulse of negative potential to the electrodes of the other set 13, 12. In this manner the liquid crystal 11 will only be actuated at the intersection of energised electrodes 12,13, the pulse on each individual electrode 12,13 being of insufficient potential to actuate the display when the electrode of the other set 13,12 is not energised.

A glass sheet 14 is positioned in front of the radial electrodes 12. A series of transparent conductive pads 15 is formed on the front surface of the glass sheet 14, each conductive pad 15 overlying a different set of the radial electrodes 12.

The set of radial electrodes 12 underlying each conductive pad 15 is divided into two groups X and Y. One of these groups X is connected to means by which read signals may be applied simultaneously to all the electrodes 12 in the group X. The group Y of electrodes 12 are connected to a sensing circuit. When read pulses are applied to the electrodes 12 in group X, the pulses are transmitted capacitively via the conductive pad 15 to the electrodes 12 in group Y and the output pulse on these electrodes 12 may be detected by the sensing circuit. If an electrical load is applied to the conductive pad 15 by, for example, a person touching the conductive pad 15, the capacitive coupling between the electrodes 12 in group X and those in group Y will be greatly reduced and there will be a corresponding reduction in the strength of the signal on the electrodes 12 in group Y. This reduction in the signal on the electrodes 12 in group Y may be detectd by the sensing circuit and used to effect a switching action.

As the electrodes 12 are used for both switching and display purposes, the two functions must be carried out at different times. Furthermore, the read pulses must not be of sufficient strength to actuate the display. However, conveniently the same circuitry may be used to apply read and display pulses to the electrodes 12, the electrodes 13 being earthed when the read pulses are applied, so that the potential across the display medium 11 will not be sufficient to actuate the display and also capacitive coupling of groups X and Y of electrodes 12, via electrodes 13, will be avoided.

Various modifications may be made without departing from the invention. For example other arrangements of first and second sets of electrodes 12, 13 and conductive pads 15 and other forms of display may be used. While in the above embodiment we have described a switch/display unit including several switches, individual switch/display units may be formed in this manner.

In the embodiment described above the read and sense electrodes for switching purposes are formed by different groups X and Y of the radial electrodes 12. Instead of dividing the electrodes 12 into two groups X and Y, an additional electrode may be provided between the display medium 11 and glass sheet 14, to perform the function of one of the groups of electrodes. With this arrangement the full set of electrodes 12 would, for example, be used as read electrodes while the additional electrode would be used as a sense electrode. In a polar arrangement of the form described above, each switch may be provided with an additional sense electrode of arcuate form, positioned either internally or externally of the ring of radial electrodes 12, the conductive pads 15 would then be extended to cover the set of electrodes 12 and additional electrode.

Finally it should be noted that the accompanying drawings are diagramatic illustrations only. They are not intended to indicate the relative dimensions and particularly thicknesses of the components. Typically, the glass sheet 14 will be of the order of 3mm thick, while the various electrodes 12, 13 and conductive layer 15 will be of the order of 0.05 microns thick. Furthermore, the sets of electrodes 12 and 13 would typically contain between 20 and 40 electrodes per centimeter

CLAIMS

1. A switch/display unit comprising a transparent dielectric panel, a first set of elongate electrodes formed from transparent conductive material on the rear surface of said dielectric panel, a display medium disposed between said first set of electrodes and a second set of elongate electrodes, said electrodes of the first set overlapping those of the second set to form a matrix of dots, each dot defined by the intersection of a unique pair of electrodes, one from the first set and one from the second set, and a transparent conductive layer 15 formed in front of the dielectric panel and overlying the first set of electrodes.

2. A switch/display unit according to claim 1 wherein the first set of electrodes are in a radial array and the second set of electrodes are in a concentric annular array.

3. A switch/display unit according to claim 1 or 2 wherein the transparent conductive layer is a pad and the first set of electrodes underlying the pad is divided into two groups X and Y, one group X being connected to means by which read signals are applied to all the electrodes in the group X and the group Y of electrodes being connected to a sensing circuit.

4. A switch/display unit according to claim 1 or 2 wherein an additional electrode is provided between the display medium and the dielectric panel, the additional electrode acting as a sense elctrode and the first set of electrodes acting as read electrodes.

5. A switch/display unit substantially as described with reference to the drawings.

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